III B.Tech I Semester

15AME27 - HEAT TRANSFER

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Course Objective:

The students will gain the ability to get an in-depth understanding of the principles governing the transfer of heat, the techniques , tools and skills required to solve typical thermal related problems, the analysis of energy flows in complicated systems and the design of efficient heat transfer equipments. Enables the student to utilize analogies to solve heat transfer problems. Further students gain hands-on experience in heat transfer experimentation through a number of laboratory tests.

UNIT I

Introduction: Modes and Mechanisms of Heat Transfer - Basic Laws of Heat Transfer - General Applications of Heat Transfer.

Conduction Heat Transfer: Fourier Rate Equation - General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates. Simplification and Forms of the Field Equation - Steady, Unsteady and Periodic Heat Transfer - Boundary and Initial Conditions.

One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres - Overall Heat Transfer Coefficient - Electrical Analogy - Critical Radius/Thickness of Insulation

Learning Outcome & Suggested Student Activities:

After the completion of the unit, student can able to grasp the concept of steady state conduction. Student can learn representing conduction equation in various forms. Student can imply concept successfully to problems encounter in day to day life

UNIT II

Heat Transfer in Extended Surface (Fins) - efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.

One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance - Significance of Biot and Fourier Numbers - Chart Solutions of Transient Conduction Systems - Problems on Semi-infinite Body.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student is expected understand the concept of extended surfaces and its applications. Also, student can aware transient heat conduction and how it vary w.r.t time. Student is expected to develop the ability to formulate practical conduction heat transfer problems by transforming the physical system into a Mathematical model and selecting an appropriate solution technique and evaluating the significance of results.

UNIT III

Convective Heat Transfer: Dimensional Analysis - Buckingham Π Theorem and Its Application for Developing Semi - Empirical Non-Dimensional Correlations for Convective Heat Transfer - Significance of Non-Dimensional Numbers - Concepts of Continuity, Momentum And Energy Equations.

Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over - Flat Plates, Cylinders and Spheres.

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Internal Flows: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths - Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow, Annular Flow.

Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate - Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

Learning outcome & Suggested Student Activities:

At the end of the chapter, Student will have the ability to formulate practical forced and natural convection heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique and evaluating the significance of results. Students will also demonstrate an ability to analyze the performance.

UNIT IV

Heat Transfer With Phase Change: Boiling, Pool Boiling - Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Filmwise and Dropwise Condensation - Nusselt's Theory of Condensation on a Vertical Plate - Film Condensation on Vertical snd Horizontal Cylinders Using Empirical Correlations.

Heat Exchangers: Classification of Heat Exchangers - Overall Heat Transfer Coefficient and Fouling Factor - Concepts of LMTD and NTU Methods - Problems using LMTD and NTU Methods.

Learning outcome & Suggested Student Activities:

After the completion of the chapter, student will be able to calculate heat transfer in condensation and boiling systems, turbulent and laminar film condensation. Student can understand the concepts of critical heat flux and different models of critical heat flux. Student can able to grasp the fundamentals of heat exchangers and its analysis.

UNIT V

Radiative Heat Transfer: Emission Characteristics and Laws of Black-Body Radiation - Irradiation - Total and Monochromatic Quantities- Laws of Planck, Wien, Kirchoff, Lambert, Stefan And Boltzmann - Heat Exchange Between Two Black Bodies - Concepts of Shape Factor - Emissivity - Heat Exchange Between Gray Bodies - Radiation Shields - Electrical Analogy for Radiation Networks.

Learning outcome & Suggested Student Activities:

At the end of the unit, student can have knowledge on fundamental laws of radiative heat transfer. Also, student can understand the concept of radiative heat transfer between black bodies and grey bodies. Student can know radiation shields and their applications. Student can determine shape factor for different geometries and can know its importance in determining radiative heat transfer.

TEXT BOOKS:

1. Fundamentals of Engg. Heat and Mass Transfer, R.C. Sachdeva, 4/e, New Age International.
2. Heat and Mass Transfer, R.K.Rajput, S.Chand& Company Ltd, 2001.

REFERENCE BOOKS:

1. Heat Transfer, P.K.Nag, 3/e, TMH, 2011.
2. Heat Transfer, Ghoshdastidar, Oxford Univ. Press, 1st edition, 2004.
3. Heat Transfer, Holman.J.P, 10/e, TMH, 2012.
4. Fundamentals of Heat and Mass Transfer, Kodandaraman, C.P., 3/e, New Age Publ.
5. Fundamentals of Heat and Mass Transfer, Incropera, 5/e, Wiley India.

6. Thermal Engineering Data Book, B.S.Reddy and K.H.Reddy Rev/e, I.K. International, 2007

NOTE: Heat transfer Data books are permitted for Exam.

Web References:

- http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304
- http://web.cecs.pdx.edu/~gerry/heatAnimations/sphereTransient/#TOC
- http://www.youtube.com/watch?v=9WwSaIP5pbs
- http://www.youtube.com/watch?v=HIYCR7gXXFo;
- http://www.youtube.com/watch?v=S57nIs503fA
- http://energy.concord.org/ir/experiments-page3.html
- http://www.youtube.com/watch?v=cMmREKOhIV8
- http://www.youtube.com/watch?v=HiX7DKUlAOM
- http://www.youtube.com/watch?v=Gu1ApKpcxQc
- http://energy.concord.org/ir/experiments-page5.html

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